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and the sphere being $x^2+y^2+z^2-r^2=0 \dots \dots \dots (2)$, the condition that (2) is touched by (1) is

$$\frac{x'^2}{a^4} + \frac{y'^2}{b^4} + \frac{z'^2}{c^4} - \frac{1}{r^2} = 0 \dots \dots \dots (3).$$

a concentric ellipsoid.

69. Proposed by WILLIAM SYMMONDS, A. M., Professor of Mathematics and Astronomy in Pacific College, Santa Rosa, P. O., Sebastopol, Cal.

Find the locus of a point equidistant from the circumferences of two fixed circles.

Solution by ELMER SCHUYLER, High Bridge, N. J.

Let radii be a and b , and $OO'=c$.

$$OP = \sqrt{(x^2+y^2)} \dots \dots \dots (1), \quad O'P = \sqrt{[y^2+(c-x)^2]} \dots \dots \dots (2).$$

By condition, $O'P - OP = b - a$.

$$\therefore \sqrt{[(c-x)^2+y^2]} - \sqrt{x^2+y^2} = b - a \dots \dots \dots (3).$$

Clearing of fractions gives us $[c^2 - (b-a)^2 - 2cx]^2 = 4(b-a)^2(x^2+y^2) \dots (4)$.

This is a conic section and an ellipse, hyperbola, parabola (or particular case) according as $(b-a)^2[(b-a)^2 - c^2] >, <, \text{ or } = 0$.



NOTE ON RIGHT TRIANGLES.

Every right-angled triangle has two concealed roots. By three different combinations of the two roots, the three sides are formed. The longest side is the sum of the squares of the two roots. The second side is the difference of the squares of the two roots. The third side is twice the product of the two roots.

The perimeter is equal to twice the greater root multiplied by the sum of the two roots. The area is equal to the product of the two roots multiplied by the product of the sum and difference of the two roots.

A prime right-angled triangle is one whose sides are integral and cannot all be divided by the same number without a remainder. A prime triangle is the result of having one of the roots odd and one even. Exception.—If the even root is just twice the odd root, the resulting triangle will not be prime, as its sides will all be divisible by the square of the odd root.

If both the roots be odd or both even the sides of the triangle will be divisible by two and the triangle will not be prime. Any odd number may be one side of a prime triangle; in many cases the same odd number will serve as one side of several different prime triangles, as for example, 13, 12, 5, and 13, 84, 85. Any even number divisible by 4 can be one side of a prime triangle as a prime triangle has always one even side. The digit, 2, must be a factor twice, or both the roots will be odd numbers. The same even number may be a side of several prime triangles, as 12, 13, 5, and 12, 35, 37.

A prime right-angled triangle has two of its sides expressed by odd numbers. Find the sum and the difference of these. Each will be the double of a perfect square. The square root of one-half the sum will be the greater root of

the triangle, and the square root of one-half the difference will be the lesser root of the triangle.

Next take the hypotenuse and the even side of any prime right-angled triangle. The sum and the difference will each be a perfect square number, and their square roots will be the sum and the difference of the two roots of the triangle.

A given area, or a given perimeter, can belong to but one prime right-angled triangle, and either the area or the perimeter being given it is easy to find the other dimensions. In case of one side only being given it has been shown that the given side may belong to several different triangles, but all of them are easily found.

C. W. SHEDD.

Columbus, Miss.



PROBLEMS FOR SOLUTION.

ARITHMETIC.

110. Proposed by F. P. MATZ, Sc. D., Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pa.

By measuring with a yard $m=12\frac{1}{2}\%$ *too short*, my profits are $n=25\%$ of my sales. If my yard be $p=10\%$ *too long*, what per cent. of my sales will be my profits?

111. Proposed by F. P. MATZ, Sc. D., Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pa.

By what per cent. of its original dimensions must a linear yard of steel rail, weighing 60 pounds, be increased so that it may weigh 75 pounds?

** Solutions of these problems should be sent to B. F. Finkel not later than May 10.

ALGEBRA.

98. Proposed by B. F. FINKEL, A.M., M.Sc., Professor of Mathematics and Physics, Drury College, Springfield, Mo.

A and B agreed to reap a field of grain for 90 shillings. A could reap it in 9 days, and they promised to complete it in 5 days; but B, who did not work as quickly as he expected, was obliged to call to his assistance C, an inferior workman, who worked the last two days, in consequence of which B received 3s. 9d. less than would otherwise have been due him. In what time could B and C each reap the field? From *Milne's High School Algebra*.

99. Proposed by C. H. JUDSON, Greenville, S. C.

Seven persons met at a summer resort, and agreed to remain as many days as there are ways of sitting at a round table, so that no one shall sit twice between the same two companions. They remained fifteen days. It is required to show in what way they may have been seated.

** Solutions of this problem should be sent to J. M. Colaw not later than May 10.